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I might also mention that in the case of the N.P.D.'s, where the tabular quantities are sometimes rapidly increasing and sometimes rapidly decreasing, I find that with our present reckoning of time the tabular N.P.D.'s are systematically larger than the observations whenever the N.P.D. is rapidly increasing, and smaller than the observations whenever the N.P.D. is rapidly decreasing, and that these discrepancies are sensibly removed in my corrected results.

Determinations of Longitude on the East Coast of Africa. By W. H. Finlay, B.A., Chief Assistant, Royal Observatory, Cape of Good Hope.

It was decided in 1880 that a telegraphic determination of the difference of longitude between Aden and the Cape Observatory should be made, and I left the Cape on May 28, 1881, to take part in this operation.

The opportunity seemed an excellent one for determining also the longitudes of the various ports of call on the East Coast, and I determined to avail myself of it, at the suggestion and with the co-operation of the Astronomer Royal at the Cape.

I took with me an 8-inch sextant, by Dollond, an altazimuth by Troughton and Simms (which was also used for determinations of latitude at Durban and Aden), and three chronometers, viz. Parkinson and Bouts 801, Cribb 722 (both mean time), and Dent 1589 (sidereal).

The sidereal chronometer was always used for observing, and was always compared before and after observations with the others, which were kept while on board in my cabin, where the changes of temperature were not considerable.

The altazimuth was one of those used in the Transit of *Venus* Expedition, 1874, and a full description of it will be found on page 18 of the British Observations of the Transit. The values of the divisions of the spirit-levels were determined before I left the Cape, and at every observation the preceding and following divisions of the vertical circle were always read; so that the corrections of runs of the microscope micrometers at any place were always determined from the observations there; this correction, however, was very small. The sextant was in good adjustment. Observations at about the same altitude as those actually made during the Expedition were made before leaving, and showed that no sensible correction was required to the resulting local time for excentricity.

I arrived at Lourenço Marques (Delagoa Bay) on July 2, and by the kindness of the superintendent was allowed to take up my quarters at the station of the Eastern and South African Telegraph Company till the arrival of the British India Company's steamer, which was to take me on to Aden.

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The Eastern Company's stations on this coast are Durban, Delagoa Bay, Mozambique, and Zanzibar; and every facility was given me by the superintendents at these places for sending signals through the cable. At Durban there is a short line connecting the Government telegraph office (land line) with the cable office, and there is direct communication between the Government office and the Cape Observatory. On my way to Aden the signals from my end of the cable were noted at Durban and sent on to the Observatory by H. McEwen, Esq., of the Eastern Telegraph Company's staff, and similarly for the signals from the Observatory. Some delay must necessarily occur in such translation, but it will be seen from the results that the delay was very short and constant. On my return to Durban Mr. McEwen and I observed a large number of mirror signals sent from Aden in order to determine our personal equation, and we found that the difference of our estimates of the start of the spot of light was practically insensible, while any error in catching the click of the Morse lever must certainly be small, and quite within the errors of the time determinations. On my return journey Mr. Maclear, of the Cape Observatory, occupied the Durban longitude station, and my signals were exchanged with Durban only. The cable does not touch at Inhambane or Quilimane, so that I had to trust to my chronometers for any determinations at these places; but the interval for which the rate had to be assumed was only a few days.

Table I. gives the average rates of the two mean time chronometers, deduced from cable signals and from comparisons with the Transit Clock at Durban.

These average rates necessarily, in some cases, include the disturbing effects of landing or shipping the chronometers; and I had no material for correcting the rates for change of temperature. They have only, however, been used (1) for the observations at Quilimane, and (2) for deducing the rate of the observing chronometer between the times of observation and of signals at the other places.

TABLE I.

Rates of the Standard Chronometers.

Approximate Cape Mean Time.	Interval.	Cribb.	P. & B.	Remarks.
d h	d	s	s	
July 1 21				
	11·38	+0·11	+1·14	At Delagoa Bay.
13 6				
	15·75	+0·11	+0·84	From Delagoa Bay to Zanzibar.
29 0				
Oct. 4 19				
	12·69	−0·47	+1·14	From Aden to Zanzibar.
17 12				
	6·43	+0·12	+1·66	From Zanzibar to Mozambique.
23 22				
	10·47	+0·28	+1·68	From Mozambique to Delagoa Bay.
Nov. 3 7				
	6·55	+0·61	+1·22	At Delagoa Bay.
9 21				
	6·07	+1·65	+2·09	From Delagoa Bay to Zanzibar.
15 22				

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The stay of the British India steamers at Inhambane, Quilimane, and Mozambique, never exceeds twenty-four hours. There are no boats for hire at these places, and we sometimes arrived at night, so that it may be easily understood the time at my disposal was generally short. At Zanzibar the steamer usually stopped two days. I was able to land the altazimuth here each time, and also at Mozambique on the return journey.

I will now give an account of the stations occupied, the observations, and their results.

DELAGOA BAY.

July 6–13.—These observations were altitudes of the Sun with the sextant and artificial horizon at the flag-staff of the E.S.A.T.C. This is a well-marked position on the top of the hill at Punta Vermelha (Reuben Point).

Latitude.

Date.		No. of Observations.	Observed.	Adopted.
			° ′ ″	° ′ ″
July	6	8	−25 58 4	
	7	6	−25 58 11	−25 58 4
	13	12	−25 57 55	

For time the chronometer error is given from the mean of morning and afternoon determinations.

Time.

Date.			Dent slow on local sidereal time.		
	d	h	h	m	s
July	7	0	1	6	49·1
	11	0	1	6	58·8
	12	0	1	7	2·5
	13	0	1	7	7·6
	13	12	1	7	9·0

Signals were exchanged with the Observatory on the night of July 13, with hand-translation at Durban. These give for the difference of longitude

	h m s
From Cape Signals	0 56 28·6
,, Delagoa Bay Signals	27·2
Mean	0 56 27·9

And the "retardation" or "loss of time" = $0^{s}\!\cdot\!7$.

I left Delagoa Bay on July 15.

November.—On my return journey constant rain and cloudy weather prevented any observations until the day before I left. On November 9, at 18^{h} mean time, I exchanged signals with Mr.

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Maclear at Durban, and secured observations of the Sun with the sextant directly afterwards. These give for the difference of longitude between Durban and Delagoa Bay

	h	m	s
From Durban Signals	0	6	15·37
„ Delagoa Bay Signals			15·01
Mean	0	6	15·2

And retardation = $0^s \cdot 18$.

No results could be obtained at Inhambane on either visit owing to cloud.

QUILIMANE.

(*Assumed latitude* −17° 51′ 44″.)

July 1.—I landed about 6 A.M., and made observations of the Sun on the steps of the north-east side of the Custom House. The choice of this site was somewhat unfortunate, as shortly after I had commenced numbers of people kept passing in and out for transaction of business, and disturbed the mercury as they passed; but as I had only about an hour at my disposal I did not think it advisable to look out for another well-marked place. We left at $10^h\ 30^m$ A.M.

The errors of the standard chronometers have been deduced from the signals at Zanzibar on July 28 and 29, with the rates in Table I.

At the time of the second comparison of Dent with the standards (i.e. after the observations) these latter differed $0^s \cdot 86$ in giving Cape mean time: the mean of the two has been adopted. These observations make my station

h m s
1 13 33·6 East of the Cape.

The probable error of the local time, obtained from the discordances of the separate observations, is $\pm 0^s \cdot 3$.

MOZAMBIQUE.

Arrived Saturday evening, July 23. I landed next morning, and took sextant observations of the Sun in an open space among the trees in front of the Telegraph Office. The flag-staff in Sebastian Fort is 1,027 feet distant, and bears 74° 15′ East of North from this place.*

I exchanged signals with Mr. McEwen at Durban, but failure of the land-line and bad weather for the next three or four days prevented his getting any exchange with the Observatory. I

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* For this determination I am indebted to Captain Aldrich, R.N., and the officers of H.M.S. "Fawn."

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have therefore deduced the errors of the standard chronometers as at Quilimane. These observations make my station

$$1^{h}\ 29^{m}\ 5^{s}\cdot6 \text{ East of the Cape.}$$

The reduction in longitude to the flag-staff is $0^{s}\cdot67$.

Owing, however, to the much better determination on the way back, I did not propose to give this result any weight. It happens, however, to agree almost exactly with the later one. I left on Sunday afternoon.

On the return journey, I arrived on Sunday, Oct. 23, about noon. At first the health officer refused us pratique on account of the cholera, which had been prevalent at Aden for some time before I left; but we were allowed to land in the afternoon. The Governor, Vasconde P. d'Arcos, offered me every facility for making my observations in Sebastian Fort, and the observations on this occasion were made with the altazimuth, in the S.E. augle of the Fort, about ten or twelve yards South of the flag-staff.

Latitude.

Star.	Observed.	Adopted.
	° ′ ″	° ′ ″
α Piscis aust.	−15 1 47·3	−15 1 47
α Eridani	46·4	

Time.

The results are corrected for the rate of chronometer Dent, so as to reduce them to a common epoch.

Star.	Chronometer fast	Direction of Star.
	h m s	
θ Scorpii	5 11 25·91	West of Meridian.
α Tauri	26·22	East ,,
α Piscis aust.	25·98	West ,,
β Orionis	26·40	East ,,

Signals could not be got with Durban that night, but were exchanged about 6 A.M. next morning with Mr. McEwen, and the chronometer used by him was shortly afterwards compared with the Durban Transit Clock. The results for the difference of longitude are

	h m s
From Durban Signals	0 38 53·77
,, Mozambique Signals	53·13
Mean	0 38 53·45

And loss of time = $0^{s}\cdot32$.

The horizontal circle of the altazimuth was also read approximately with each of these stars, and for the light on St. George's

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Island. According to these observations, which agree well among themselves, the light bears 60° 24′ East of South from my station.

ZANZIBAR.

Arrived July 28. Dr. (now Sir John) Kirk had built a pillar for the altazimuth on the roof of the Consulate on a solid partition-wall, which ran right through to the ground; but, unfortunately, the pillar was too small to carry the foot-screws. (The late) Captain Brownrigg, H.M.S. "London," most kindly placed the services of his engineers at my disposal, and they cast a brass plate about three-quarters of an inch thick, which was firmly bolted to the pier next morning. The observations on the 28th were made on the top of the altazimuth box; those on the 29th on the pier.

Latitude.

Date.	Star.	Observed.	Adopted.
		° ′ ″	° ′ ″
July 29	α Lyræ	−6 9 48·9	−6 9 51
	α Gruis	53·2	

Time.

Date.	Star.	Chronometer slow.	Direction of Star.
		h m s	
July 28	α Virginis	1 34 1·92	West of Meridian.
	α Scorpii	2·39	West ,,
	α Andromedæ	2·14	East ,,
July 29	α Virginis	1 34 6·54	West ,,
	α Aquarii	6·06	East ,,
	α Scorpii	6·33	West ,,
	γ Pegasi	6·24	East ,,

Signals were exchanged with the Cape Observatory each night, with hand-translation by Mr. McEwen at Durban. The results for difference of longitude are:

		h m s	h m s
July 28	From Cape Signals	1 22 51·18	1 22 50·1
	,, Zanzibar Signals	48·97	
July 29	,, Cape Signals	50·55	1 22 49·5
	,, Zanzibar Signals	48·43	
	Mean		1 22 49·8

And the "loss of time" on the two nights is $1^{s}·10$ and $1^{s}·06$ respectively.

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Throughout these observations I experienced the greatest kindness and assistance from the members of the E.S.A.T.C., and my thanks are especially due to Messrs. Heraghty, Cassidy, Carlisle, McEwen, and to Sir J. Kirk.

It will be interesting to compare the "retardation," or "loss of time," at the different places. The average loss from Cape Town to Durban was about $0^{s}\cdot2$. We have then :

	s	
Cape to Delagoa Bay	0·7	(with hand-translation).
Durban to Delagoa Bay	0·2	
Durban to Mozambique	0·3	
Cape to Zanzibar	1·1	(with hand-translation).

From the first two results it appears that the "loss of time" due to the hand-translation was about $0^{s}\cdot3$; and applying this to the last result, the "loss" on the cable from Durban to Zanzibar would be $0^{s}\cdot6$.

The following table gives the results of my observations. The longitudes used for the Cape Observatory ($1^{h}\ 13^{m}\ 54^{s}\cdot7$) and the Durban Hut ($2^{h}\ 4^{m}\ 6^{s}\cdot9$) have been taken from Mr. Gill's *Preliminary Account of a Telegraphic Determination of the Longitude of the Royal Observatory, Cape of Good Hope.*

FINAL RESULTS.

Place.	Position of Station.	Date.	Longitude East of Greenwich.	Longitude in Arc.
			h m s	° ′ ″
Delagoa Bay	Flag-staff, E.S.A.T.C.	July 13	2 10 22·6	32 35 35
		Nov. 9	2 10 22·1	
Quilimane	Custom House	July 20	2 27 28·3	36 52 4
Mozambique	Flag-staff, Sebastian Fort	July 23	2 43 0·3	
		Oct. 23	2 43 0·4	40 45 6
Zanzibar	British Consulate	July 28	2 36 44·8	39 11 8
		July 29	2 36 44·2	

Royal Observatory,
Cape of Good Hope:
1883, *May.*

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Ephemeris for Physical Observations of Mars, 1883–84.

By A. Marth.

Greenw. Noon. 1883.		P.	Areographical Longit. of Disk's Centre.	Latit.	Diameter.	*q*	Q	E	Log. Light-ratio.
		°	°	°	″	″	°	°	
Oct.	20	352·47	191·53	+14·75	7·10	0·81	283·53	39·37	9·1286
	22	353·08	172·38	15·06	7·18	·81	283·86	39·36	·1375
	24	353·68	153·24	15·35	7·27	·82	284·17	39·33	·1467
	26	354·27	134·12	15·63	7·36	·83	284·47	39·29	·1561
	28	354·86	115·01	15·90	7·45	·84	284·75	39·23	·1657
	30	355·44	95·91	16·16	7·55	·85	285·02	39·16	·1756
Nov.	1	356·00	76·83	+16·40	7·65	0·85	285·29	39·07	9·1858
	3	356·55	57·77	16·64	7·75	·86	285·54	38·96	·1962
	5	357·09	38·73	16·86	7·85	·87	285·77	38·84	·2069
	7	357·62	19·71	17·07	7·96	·87	285·99	38·70	·2178
	9	358·14	0·70	17·27	8·07	·88	286·20	38·54	·2290
	11	358·64	341·71	17·46	8·18	·88	286·39	38·36	·2405
	13	359·13	322·75	17·64	8·30	·89	286·57	38·17	·2522
	15	359·60	303·81	17·80	8·42	·89	286·73	37·95	·2642
	17	0·06	284·89	17·96	8·55	·89	286·88	37·70	·2765
	19	0·50	266·00	18·10	8·68	·89	287·02	37·43	·2890
	21	0·93	247·13	18·23	8·81	·89	287·14	37·14	·3018
	23	1·34	228·29	18·34	8·95	·89	287·25	36·82	·3149
	25	1·72	209·48	18·45	9·09	·89	287·34	36·48	·3282
	27	2·08	190·70	18·54	9·24	·89	287·41	36·10	·3417
	29	2·43	171·96	18·62	9·39	·88	287·46	35·69	·3555
Dec.	1	2·76	153·25	+18·68	9·54	0·87	287·50	35·25	9·3695
	3	3·06	134·58	18·74	9·70	·87	287·52	34·78	·3838
	5	3·34	115·94	18·78	9·86	·86	287·51	34·27	·3982
	7	3·59	97·34	18·81	10·02	·84	287·49	33·72	·4128
	9	3·82	78·78	18·82	10·19	·83	287·45	33·14	·4275
	11	4·03	60·27	18·83	10·36	·81	287·38	32·52	·4424
	13	4·21	41·80	18·82	10·53	·79	287·29	31·86	·4574
	15	4·35	23·37	18·79	10·71	·77	287·18	31·15	·4725
	17	4·47	4·99	18·76	10·89	·75	287·03	30·40	·4877
	19	4·56	346·66	18·71	11·08	·72	286·86	29·60	·5029
	21	4·62	328·37	18·65	11·26	·69	286·65	28·76	·5180
	23	4·65	310·14	18·57	11·45	·66	286·41	27·87	·5331
	25	4·65	291·96	18·48	11·63	·63	286·13	26·93	·5480